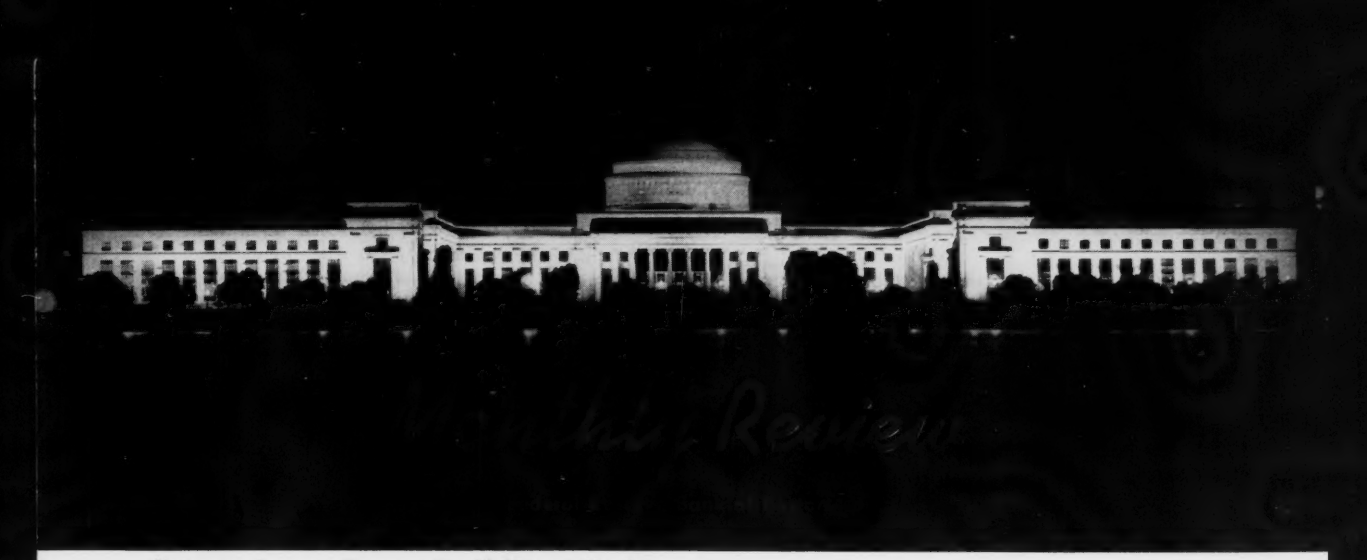

MASSACHUSETTS INSTITUTE OF TECHNOLOGY: Central Building on the Main Campus.

Industrial Opportunities in New England

Summary of Conclusions and Recommendations

This summary of the conclusions and recommendations of the Arthur D. Little, Inc., study of Industrial Opportunities in New England is the second in a series of articles appearing in the *Monthly Review*. A reproduction of the complete study may be obtained for $2.00 on request to the Research and Statistics Department, Federal Reserve Bank of Boston, 30 Pearl Street, Boston 6, Massachusetts.

NEW ENGLAND is one of the oldest industrial regions in the United States. Its economic problems are those of maturity; to assure a continuing high level of employment and income it must adapt its present industry to new technology, it must introduce new products and it must divert resources from declining sectors of the economy to newer, growing industries.

The material resources and human skills available for the job of industrial development in New England, as well as such factors as taxes and community environment, have been exhaustively analyzed in numerous reports. Such information is a necessary starting point in an investigation of industrial opportunities. It must be emphasized, however, that these factors are highly specific. New England is generally lacking in the raw materials of industry, and yet for certain industries such as pulp and paper there is an important materials base in the region. Similarly, it is difficult to generalize about other economic factors such as power costs, labor supply, and taxes. These matters must be examined industry by industry, locality by locality. No summary statement can be at once accurate and meaningful.

Preliminary selection of industrial opportunities can be initiated by establishing an over-all frame of reference for the New England economy. This approach includes recognition of New England's geographic position in the far northeastern corner of the United States. It recognizes the fact that it is generally poor in raw materials; that for the most part its power costs are high in comparison with competing regions; that in some jurisdictions taxes on business enterprises are burdensome; that many of its industrial plants are old and ill-arranged for efficient production; that in some lines labor costs are high; and that, in certain industries, management tends to be unprogressive. This approach also recognizes that for many industries New England furnishes an excellent supply of skilled labor on terms at least as favorable as those in competitive regions; that New England has ample supplies of process and cooling water; that many New England managements, especially those in the growth industries, are imaginative and enterprising; that New England has a large regional market and, for many lines, access to a much larger national market; and that the availability of capital for certain types of new enterprises may be greater than in other regions. Finally, this approach recognizes that the research facilities of New England as an aid to business enterprises are unrivaled by those of any other section of the country.

General Guideposts to Industrial Opportunities

Considerations such as the above lead to several useful rules of thumb in searching for industrial opportunities in New England. The best opportunities are likely to be found in products which satisfy one or more of the following requirements:

1. Need for skilled labor;
2. High value added;
3. A unique product or specialty goods;
4. Need for management ingenuity and patience;
5. Small bulk, high value;
6. A material base in the region, in Eastern Canada, or overseas;
7. Orientation to a local market;
8. Origin in technical research.

There are doubtless other requirements which might be offered but the above list is suggestive of how a search for industrial opportunities in New England may be

advanced by discovering promising possibilities that warrant more intensive investigation.

It is quite clear that few of the opportunities are likely to be based on local materials, and that most of them are available to New England because of its human resources. It is also true that many of the industries of New England owe their location to market orientation, national or regional.

Industrial Opportunities in New England

Industrial opportunities are highly specific; what is available to one firm is ill adapted to another. Despite this requirement of unique adjustment, it is possible in a general way to point out promising opportunities for those firms which command the resources necessary to develop them.

Steel. The volume of metal fabrication conducted in New England, when converted into total demand for iron and steel products, substantially exceeds the productive capacity of the existing non-integrated producers of steel. Thus, New England is a deficit area, and the great majority of the market demands must be filled by purchase of steel from distant mills. Extensive investigation of a large integrated steel mill by several New England groups has not resulted in positive action to establish such a mill. Preliminary examination, however, indicates that a smaller nonintegrated steel mill may be well suited to New England's needs. Such a mill would be designed to satisfy perhaps one-half of the region's postwar annual demand of 122 thousand tons of alloy steel bars and shapes, and one-fourth of the postwar annual demand of 375 thousand tons of carbon steel bars. Thus, this smaller specialty mill of about 140 thousand tons annual capacity would be geared to the needs of the principal metalworking industries of New England, one of the fastest growing segments of the economy. In the regional market such a mill would enjoy a freight advantage over competitors in other areas. Since New England is a surplus area for scrap, an electric furnace melting a scrap charge would be both economically and technically practical. Integration of such a furnace with a continuous casting mill would further improve the economics of operation. A steel mill is a strategic element in regional development; it is probable that many steel-using industries would expand if the principal grades of specialty steel were available from a New England mill.

Aluminum. Of the light metals, aluminum has undergone the most remarkable expansion in production. When facilities now under construction in the United States are completed in 1953, the industry will be approximately five times larger than it was in 1941 and about fifteen times greater than it was in 1931. While a high percentage of this production is currently going to military applications, some well-informed sources believe that civilian demands will be adequate to absorb the quantities released by the military and still leave a deficit in capacity for the future. Several factors account for the phenomenal growth of the industry: the utilization of new techniques in metalworking, the reduction in price of aluminum, and the application of aluminum to new technical uses in electrical-equipment manufacture, in the automotive industry and in building construction. Since New England is well represented in many of the important user industries, the growth of the basic aluminum industry is worth considering.

Plants for the separation of alumina from bauxite are in many cases not contiguous to aluminum reduction plants, and bauxite is shipped by water from such sources as British Guiana and Jamaica. Consideration might be given, therefore, to the broad feasibility of utilizing New England ports for the establishment of alumina separation facilities to serve the requirements of such reduction plants as those of the Aluminum Company of America at St. Lawrence and Massena, New York. Fuel is an important cost of operating a separation plant, and careful study would have to determine whether New England's disadvantage in this regard would preclude establishment of a plant. In the case of reduction of alumina to aluminum metal, high power requirements prevent economical operation of a plant under present conditions in New England.

Before useful articles can be manufactured from metallic aluminum of the reduction plant, the metal must be fabricated into standard forms such as sheets, rods, bars and other shapes, or else cast. Fabrication plants are scattered and in only a few instances are located contiguous to reduction plants. In view of the fact that aluminum metal is available by water from Gulf ports and by rail from points geographically close to New England, consideration might be given to the establishment of new fabrication plants for primary shapes. Such facilities would be concerned chiefly with production of a larger and wider variety of aluminum shapes than that now available from the brass and copper mills of Connecticut. Although domestic facilities for fabrication of aluminum shapes are in excess of the capacity for producing primary ingot, Aluminium, Ltd., of Canada has fabrication capacity which is only 27 per cent of its current ingot capacity and 20 per cent of its potential capacity when current expansion plans for aluminum reduction are completed. This provides an obvious source of aluminum metal for an independent fabricator located in New England.

Titanium. In the opinion of many metallurgists titanium metal has a possible application potential equal to that of stainless steel. On an equal strength basis, its weight is less than that of aluminum and stainless steel, and its corrosion resistance is outstanding. Because of its ability to be surface-hardened, titanium should find considerable use for parts subject to abrasive wear, such as pistons, cylinders and other engine components. These characteristics promise a wide range of applications as soon as further technical development has reduced the price of the metal ($5.00 per pound for sponge, and $14.00 in shapes). Currently, only those applications which require the particular characteristics of the metal can justify the high cost, and such applications are mostly of a military nature.

If present technical work on the Kroll process for reduction of titanium is successful, the possibility of New England as the location for a reduction plant would appear feasible. The area is strategically located with respect to one of the more prominent and growing sources of titanium materials, the deposits at Sorel, Quebec. If a titanium reduction plant is established in New England, facilities for production of primary shapes could then be economically established.

Petroleum.

New England is a major deficit area for refined petroleum products. The region's demand for fuel oil is 11.5 per cent of that of the entire United States, and it is estimated that by 1955 total sales of fuel oil will approximate 136.6 million gallons. It is believed that gasoline consumption will also continue to expand and will reach a total of 2.4 billion gallons in 1954. New England produces refined products to satisfy only a small fraction of this demand. It has only three operating refineries, the largest of which produces only 40 thousand barrels per calendar day. The bulk of the refined products consumed in New England comes from the Gulf Coast.

Several companies have considered establishing large-scale refineries in New England and have decided against it; but in each case the decision is said to have been made by a narrow margin. In the past it has been considered more economical for the major oil companies to increase the size of their refineries established on the Gulf or Mid-Atlantic Coast. It is entirely possible, however, that a point may be reached when it is no longer advantageous to add to existing large refineries. In this case, the construction of a large refinery at tidewater in New England may be justified. One factor which may help in making such construction feasible is the increasing dissatisfaction with periodic shortages which have prevailed in the past. A company with a large petroleum refinery in New England would have a competitive advantage in this regard. Continuing technological advances in petroleum refining may also favor a New England plant by easing the problem of disposing of by-products. In the event that oil development in Newfoundland and Labrador might constitute a new source of supply, the position of a New England refinery would be improved. It seems likely that, in the future, the United States will depend increasingly on foreign sources of petroleum and this shift will probably orient the industry more favorably for New England.

Cutlery, Handtools and General Hardware.

New England has long had an enviable reputation in these products because of the recognized quality of its output. The region supplies one quarter of the nation's needs for these products. The chief advantage enjoyed by New England in this field is the combination of highly skilled labor and management of long-standing experience. Production in this field can be further expanded by increasing the diversity of lines. For example, a strong new and growing market is to be found in tools, including power tools, for the home craftsman. This domestic consumption has been profitably exploited by many midwestern companies.

Lighting Fixtures.

Growth of the fluorescent lighting field has led to rapid expansion of this industry in New England. Fluorescent lighting units use considerably more steel and other materials than the average incandescent unit. Typically, fluorescent fixtures sell for about $20.00 instead of the average of $4.00 for an incandescent unit, thus enabling New England to increase its "income" more than indicated by the employment gains. The special qualities and design of products of several manufacturers in this region command premium prices which permit them to ship into national markets despite transportation charges. Increased demands for fluorescent lighting by retail stores, especially in suburban shopping centers, have been substantial. Another growing market is that for street-lighting equipment. As traffic burdens increase it is probable that better illumination on superhighways and major traffic arteries will be demanded. New England manufacturers of street-lighting equipment should watch carefully the opportunities for new types of lighting fixtures which will eliminate glare, together with qualities resulting in lower maintenance and operating costs. The possibility of a combined fluorescent and mercury-vapor or sodium-vapor unit and other similar sources may open the way to lower costs, thus enlarging the market. Completely enclosed weatherproof units, perhaps using Plexiglas, should lower maintenance costs.

Machinery.

The manufacture of nonelectrical machinery is the second ranking industry in New England in number of persons employed, income payments to individuals and in value added in manufacture. Orientation to the market was one of the dominant factors in the early industrial growth of New England, and textile-machinery companies, shoe-machinery companies and others were in a particularly advantageous position during the last century. With a shift in industrial growth to newer industries, such as electronics, the machinery industry must adapt itself to this new market if it is to continue to grow. The industry should seek opportunities which utilize technological skills of research organizations and skilled engineering personnel, which take advantage of New England's stable and skilled labor supply, which develop lines where raw material costs are relatively unimportant and which involve products with relatively low transportation costs.

Examples of these opportunities are to be found in electronics machinery where there is specific need for machinery designed to manufacture miniature components. Although the market is not large, the manufacture of specialized medical equipment such as the iron lung is promising because of the excellent medical resources of New England. Another example of the opportunities inherent in a reorientation of the machinery industry lies in the high development of complex electronic computing machines at Harvard University and Massachusetts Institute of Technology; these developments may offer a basis for commercial manufacture of office machines.

Transportation Equipment.

Although the transportation equipment industry ranks eleventh in manufacturing workers employed in New England and accounts for only 3.1 per cent of total manufacturing employment in the region, it is one of the few New England industries which, in the period 1939 to 1947, showed a growth rate equal to that of the United States as a whole. The industry is well adapted to New England because of the industry's requirements for a comparatively high level of manufacturing skill and the moderate or below-average requirements of industrial power.

Most of the growth is accounted for by the airplane industry, and since 1947 growth has continued even more rapidly. The United Aircraft Corporation alone has reported a backlog of orders well over one billion dollars. Defense spending of this magnitude brings prosperity to the area for the time, but it also poses a serious potential problem if government business should be drastically reduced.

Other types of transportation equipment offer less spectacular growth potentials. Although shipbuilding generally has declined, the construction of an atomic powered submarine by the Electric Boat Division of General Dynamics Corporation may have a tremendous impact on the future of shipbuilding, both in design and construction. New methods of building small boats through one-piece molding of phenolics with plywood and other plastics reinforced with glass may open the way for an expansion of boatbuilding. Another interesting part of the boatbuilding industry has been the growth in use of kits for home construction of boats. This offers an opportunity for woodworking plants, provided the boat designs are good and the assembly instructions adequate.

In the motor vehicle field, decentralization of assembly operations from Detroit to regional sites has increased employment. Although procurement policies of the major auto companies now prevent a corresponding decentralization of parts manufacture, the New England parts industry is enjoying a promising growth.

Electronics. Owing to the extraordinarily rapid rise in the importance of the electronics industry during and after World War II, and because a large share of the original development work has come from New England, this industry deserves most careful attention from those concerned with the future of New England. It has been estimated that the value of product in the United States electronics industry will attain a level of $5 billion in 1952. This represents a twenty-fold increase in the last fifteen years.

New England electronics manufacturers make tubes and semiconductors, resistors, capacitors, subassemblies, coils, hardware, transformers, insulated wire and relays. There are no large manufacturers of mass-produced domestic equipment such as radio and television receivers. A number of manufacturers make measuring and control equipment, computing and clerical equipment, and large equipment such as the Van de Graaff generator for X-ray therapy. There is also considerable manufacture of specialized military equipment.

The strength of New England's position in the electronics industry is traceable to the factors of research, labor and skilled management. The proportion of research, development and engineering personnel engaged in electronics is very high. Massachusetts Institute of Technology and research laboratories in the Boston area are the hub of electronics developments. The manufacture of electronic equipment requires workers with good eyes and a high degree of manual dexterity. New England has a large pool of stable labor to meet these requirements. Furthermore, much of the growth of electronics in this region must be attributed to progressive, research-minded management. Because much electronic equipment is combined with very precise mechanical equipment, the strong position of the machine-tool and instrument trades in New England favors the building of such equipment in New England. The design of electronic computers requires logicians and mathematicians, and design of clerical machines requires accountants as well. The schools and traditions of New England provide these skills which probably account for the high proportion of electronic development work in New England.

Two major trends in the electronics industry are towards miniaturization and the use of printed circuits instead of wiring. The use of smaller parts favors more skillful workers and perhaps even watchmakers, and there are many good watchmakers in New England. The use of printed circuits as a substitute for wiring involves a number of techniques not formerly associated with the electronics industry, but some of which have much in common with some processes like etching and silk screen printing used in the graphic arts and textile fields. Such skills are available in New England. If they could be put to work in the electronics field, New England might be able to supply printed circuit components to a large part of the electronics manufacturing industry.

Other developments in the component field promising for New England are semiconductors, including rectifiers, transistors and phototransistors. The mass-production of these components is going to be an important business, though methods are still in an early stage of development. In the manufacture of these items transportation costs are unimportant proportions of total costs, and it is likely that the availability of skilled labor in New England will be a very important deciding factor.

The trend towards *automation* (making manufacturing processes more automatic) favors New England because of its manufacturing skill. Electronic devices are used in automation for measuring, seeing, counting, remembering, computing and controlling. It would be possible, for example, to make Jacquard-type equipment which would scan an artist's pattern, compute the movements required to reproduce it, remember them, and control the highest speed loom available to reproduce them. Short runs would be little more expensive per unit than long runs.

Instruments. New England is generally considered an excellent location for manufacture of instruments, largely because of its high labor skills. Typically, companies in this field have modest power demands and freight costs are not significant. Although in the past instruments were strictly mechanical in nature, more and more electronic devices are now being employed. Because of New England's strength in electronics, the opportunity for expansion of instrument manufacture appears good. The field of atomic energy opens a vast area calling for completely new concepts of instrumentation. In this New England possesses some advantage because use of radioactive isotopes in instruments is already well advanced. In the medical and surgical instrument field, New England manufacturers can benefit from planned increases in hospital facilities in the next few years and because of the concentration of medical facilities in this region. The field of optics, already important in the region, also holds substantial promise for New England.

Glass Fiber Products. Fiberglas is produced by spinning molten glass into strands of various lengths and diameters. Its remarkable physical characteristics make it capable of a wide range of new uses. It has great strength, dimensional stability, corrosion resistance, is light in weight, and does not deteriorate in the sun. It is non-inflammable and is impervious to attack of mildew. Its electrical insulating and heat insulating qualities are also excellent. As a result of these unusual

characteristics the use of fiberglas is expanding rapidly over a wide range of applications in thermal, acoustical and electrical insulation, in filters, in textile uses and in laminates.

New England has only one fiberglas producer, but the outlook for the growth of fiberglas fabrication is quite good, particularly in textiles. About two million yards of marquisette curtain fabric was produced in 1951, and it is estimated that ten million yards will be produced in 1952. Several New England mills are already making fiberglas curtain materials. As the price of fiberglas is lowered, a number of new fields will be opened, including industrial fabrics. There are also many non-textile applications. Since this is a basically new material, its fabrication into useful products is dependent on ingenuity, technological skill, inventiveness and skilled labor — all New England assets.

Chemicals. Although the chemicals industry represents less than two per cent of New England manufacturing employment, its growth rate places it among the most rapidly expanding industries of the region. New England provides a substantial diversified regional market for chemical products, but the industry faces a serious problem in the decline of the textile and leather industries which have been major consumers of chemicals. There is a lack of most of the basic materials for the chemicals industry in New England, and relatively high power rates prevent the manufacture of certain products such as chlorine, caustic, and calcium carbide. New England's advantages lie in having an ample labor supply at rates comparable to those of the principal competing areas. The chemicals industry of the United States owes much of its phenomenal growth to research. New England's unparalleled research facilities in the chemical field can give strong support to the establishment of plants in this region.

The present strength of the New England chemicals industry lies in two fields: (1) bulk end products, such as sulfuric acid, fertilizers and paints, for local consumption: and (2) specialty chemicals characterized by a high value added in processing, the use of skilled labor, management experienced in small plant operation, and use of technological support. Examples of specialty chemicals are household products, special soaps, cleaners and polishes, and industrial materials such as emulsifiers, accelerators and anti-oxidants. There appears to be no reason why New England cannot hold its own in this type of product.

In addition to the above there are two fields whose growth potential warrants examination. Production of rayon is being expanded in New England; this growth is based on the availability of local wood pulp and an adequate market for finished products in the textile industry. One of the most promising fields for expansion is that of ethical drugs. Here, adequate process water, research facilities, the presence of outstanding hospitals and clinics, and a competent labor supply have already attracted some plants to New England.

In general, moderate growth can be expected in end products and specialties; it is likely there will also be some expansion in production of intermediates for local consumption. It seems improbable, however, that the production of basic chemicals will become one of New England's major industries.

Atomic Energy. New England research, educational and industrial facilities are already participating extensively in the national atomic energy program in spite of the fact that no major Atomic Energy Commission installation is located in the area. Contract awards from the A. E. C. to New England institutions total over $500,000,000. Practically all areas of study and experimentation of interest to the national Atomic Energy Program are covered in these contracts. To mention a few: sanitary engineering for radiation safety, metallurgy, raw materials processing, nuclear physics, medicine, biology, mathematics, agriculture and plant life. Many of the contracts are classified and cannot be disclosed for security reasons. It has been announced, however, that there are contracts in New England for building the hull for an atomic-powered submarine. There are also a number of contracts for producing radiation detection instruments.

There is also a certain amount of non-governmental atomic business, small by comparison with A. E. C. contracts, but noteworthy in terms of New England employment. It is based largely on the use of radio-isotopes in industry, medicine and agriculture. Radioactive isotopes are used for research in various fields, for medical diagnosis and therapy, as radiation sources for thickness gauges, radiographic equipment, static eliminators and a few other miscellaneous applications.

After the next ten years, one of the big questions in the atomic energy field is industrial atomic power. If atomic power is developed to a point where it can produce electricity at rates below those of commercial plants, New England is probably going to be affected more than some central and western areas in the United States because of its present higher cost of electricity. The industries which could benefit most are those producing power and its by-products and those in which power is a major factor of cost. Many of these are not now located in New England but might be attracted here by atomic power. Specific industries which normally require large blocks of power include: ground wood pulp and newsprint; electro-chemical products such as caustic, chlorine, and oxidizing agents; electrolytic products such as tin, aluminum and magnesium; and materials made in an electric furnace such as alloys, abrasives, elemental carbon, and elemental phosphorus for chemical phosphates. Lower cost power might also stimulate more domestic consumption, with secondary effects on demand for electric appliances. Thus, the long range impact of low cost electric power through atomic energy might well be very appreciable.

It is certain that atomic power in the form of electricity is technically possible (in fact, is already being produced experimentally) but only at prohibitively high rates. We strongly recommend that at least one team of New England industrial companies work under A. E. C. contracts for the commercial development of atomic power so that the results of this work could be rapidly applied to New England.

Pulp and Paper. During the early years of the twentieth century, New England maintained a dominant position in the pulp and paper industry. Since 1930, however, New England's economic position in this industry has slowly declined until it now constitutes about 15 per cent of the entire United States paper industry.

Other regions, especially the Far West, have more plentiful supplies of pulpwood of excellent quality. However, it should be noted that recent development of a process for utilizing hardwood will substantially increase New England's raw material supply. Pulp and paper mills in the West and South are run on a much larger scale and have more up-to-date equipment, such as high speed machinery, resulting in more efficient, low-cost production. In some areas, also, the availability of cheap power is a decided advantage. An expansion of pulp manufacture in New England is limited as well by a lack of available sites on rivers in proximity to wood supplies. New England enjoys a definite advantage in paper manufacture, however, in being close to markets. The region's consumption of paper products is very substantial, and nearby New York and Mid-Atlantic markets are within easy shipping distance.

There are still many opportunities for further industrial development within the pulp and paper industry. One of the most favorable opportunities lies in increasing production of high grade paper and specialty papers. Such products as writing paper, reinforced paper, wrapping papers, paper towels, ribbons, tracing and thin papers, tablets and pads, ledger paper, lamp shade papers and book paper are well suited to New England from the standpoint of its technological experience, skilled labor and available raw materials. A second type of opportunity lies in the manufacture of products based largely on technological developments, such as diapers and diaper linings, printing plates, laminated building paper, and food wrappers. Resin-bonding, synthetic and natural rubbers and new coatings applied to various materials suggest many new uses for paper products for both the consumer and industrial markets.

A new type of pulp-molding equipment is being produced by a Maine manufacturer. Although this process is still in the developmental stage, it will, when completed, make available low-cost, custom-molded packages offering maximum protection against impact. Such packaging may find a large market among industrial areas in New England in the electronics and machinery fields. The process utilizes reclaimed paper which is available in ample supply in New England.

Cement. Of the six New England states Maine is the only producer of cement. This left the region with an annual deficit of almost 7 million barrels in 1949. Much of this deficit was made up by purchases from the Lehigh Valley and New York State. There are believed to be adequate deposits of limestone available at tidewater in New England. Although fuel costs would be higher for a New England cement mill, consideration of the freight advantage enjoyed by such a producer over Lehigh Valley competition indicates an optimistic outlook for this industry. It is estimated that a net advantage of about $4.00 per ton would accrue to a New England producer over outside competition.

Plastics. New England is today the foremost section of the country for plastics fabrication, accounting for one-third of the national output. The region offers many advantages to the plastics fabricator, first of which may well be its reputation as a center of well-established firms. Another advantage of a New England location is the availability of skilled die workers who can manufacture the molds necessary for plastics molding. In many other sections of the country plastics fabricators desiring special molds send to New England die-makers for these expensive parts. A third advantage of the New England area is its accessibility to a large market. It has many plastics-consuming industries such as artificial leather and coated fabrics, electrical appliances, floor coverings, electrical wiring devices, and luggage.

In the last decade the New England plastics industry grew at a rate greater than that of the total United States. The industry can be expected to continue to grow vigorously but perhaps not at the rate experienced in the past. Among new products in the plastics field, unplasticized polyvinyl chloride has recently attracted considerable attention because it can be substituted for stainless steel in some acid-proof applications. Vinyl plastic floor tile is now produced for the home flooring market. Blow-molded polyethylene bottles are now being made by a Connecticut manufacturer for shipping hydrofluoric acid without the danger of breakage and with a lower container weight than glass.

Development of injection-molding machines for thermosetting plastics is of interest in the field of new processes. New developments include methods of molding at low pressure which use much less expensive dies than are now commonly used. Efforts are also being made to cut down the curing time for thermosetting resins in order to increase the productivity of molding machines. All of these examples are relatively new; they illustrate the growth of the industry and the necessity of being alert to new growth possibilities.

The reinforced plastics industry was born during World War II when thermosetting polyester resins were introduced. Generally fiberglas is used as a reinforcing medium. Plastic parts thus reinforced have greater strength than either steel or aluminum, weight for weight. Although there are many technical problems yet to be overcome, the potential growth of this industry is very promising. Because of its well established plastics industry it is probable that New England will share in this growth.

Printing. A highly skilled labor supply, adequate supplies of paper, and highly developed research facilities afford a basis for the resurgence of printing trades in New England. Recent technical developments offer a wide range of new processes and materials. Phototypesetting, accelerated methods of photo-engraving, the replacement of metal printing plates with rubber or plastic, and the use of a plastic blanket to reduce make-ready time — these and other developments open numerous avenues to industrial opportunity.

Rubber products. New England is at least as favorable for rubber manufacturers as are other regions of the nation. Raw material availability, labor supply, transportation services and similar basic factors are about equal with other sections. While electric power costs per kilowatt are slightly higher, the cost of electric energy constitutes a relatively small portion of total manufacturing cost. Labor skills, on the other hand, are a definitely favorable element, particularly for the high-value-added type of specialized products made by such a large proportion of New England rubber concerns.

New England manufacturers of rubber products can improve their basically favorable position by giving

attention to the possibility of increased water-borne imports direct to New England ports. A related move is the procurement of raw materials at lower prices through cooperative purchasing. Still another possibility is the development of a source of raw rubber from latex derived from *Teraxacum Kok Sagahs*, a vegetable root similar to the dandelion plant, which can be grown in New England. It is possible that new elastomer materials will have important applications to the rubber industry because of their physical properties such as reaction to ozone, abrasion resistance, and weather resistance. Still another growth opportunity may well be in expanded production of rubber floor tile for the regional market.

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An appraisal of New England's industrial opportunities inevitably comes back to the proposition that it is primarily men and only secondarily material resources which determine the economic level of a community. New England has the human resources required for the task; she can get access to many of the materials factors. The method best calculated to harness material and human resources for the continued development of New England is systematic application of technical and economic research.

Objectives and Scope

To arrive at the conclusions and recommendations, Arthur D. Little, Inc., followed predetermined methods and procedures. The following discussion of the study's objectives and scope explains the framework and methodology of the study.

This report is a study of industrial opportunities arising from advances in technology. It considers the possibilities of utilizing certain technologic improvements as the basis for industrial growth in New England. In seeking industrial opportunities available to businessmen in New England, attention has been specifically directed to three ends: (1) The development of additional and existing new markets for products which are presently manufactured by New England industry; (2) The introduction of new products; and (3) The establishment of new industries. Growth possibilities inherent in established industry and growth in new fields have been given approximately equal emphasis.

The first objective involves the determination of geographic market areas within which New England manufacturers can normally expect to sell their products. Just as there are certain products such as textiles in which New England's share of the national market is declining, so also there are some products in which the region's share of the market is underdeveloped. An extreme example of the latter is a product such as cement for which New England is a deficit area. Some of these deficits can be economically overcome by the process of having New England manufacturers expand output and compete aggressively for the regional market. It is not implied, of course, that New England would be better off if she attempted to produce *all* the manufactured goods she consumes.

The second objective concerns the diversification of New England industry chiefly by the means of having established companies introduce new products, although in certain instances new products can be more successfully initiated by new firms. Growth in this manner is based principally on the application of technologic advances to the available material and human resources of the region.

The third objective relates to establishing industries which are either new to the region — although established elsewhere — or which are altogether new in a technologic sense. The construction of a large integrated steel mill in New England would be an example of the former. The utilization of atomic power would represent the latter.

Industries Covered by This Report

This report is limited to the investigation of opportunities in manufacturing industry. In the mature New England economy tertiary industry — e.g., financial services, insurance, education, research and recreation — has grown to significant proportions. It is normal, as the industrialization of a region proceeds, to find greater employment in those occupations which serve principally the regional market, but which, in some instances, are important "export" industries. They are not treated specifically in this report because their use of modern technology is chiefly in their capacity as auxiliaries to manufacturing industry. Extractive industry and agriculture have been excluded from this report because of their minor importance in the New England economy. In the discussion of building materials, paper, and food processing, however, there is brief consideration of the extractive industries supplying the raw materials.

This report covers principally the industries and parts of industries which have demonstrated vigorous growth or which, on the basis of technological evidence, might enjoy such growth in the future. Although this study includes the largest number of major industries and many hundred individual products, there is no effort to achieve comprehensive coverage. By instruction of the Federal Reserve Bank, textiles, leather products and apparel manufacturing have been excluded from this study. It has also seemed undesirable to reopen discussion of the large integrated steel mill, a problem to which much research effort has already been devoted.

Depth of coverage varies from industry to industry. This treatment has been conditioned partly by the varying complexity of technical problems and partly by the extent to which advances in technology might be expected to influence growth.

Research Methods

The key question which was posed for our staff at the beginning of this survey was: "Given the material resources and human skills of New England, what industrial opportunities are available for development?" To answer this question three steps had to be taken. First, it was necessary to make a thorough review of the economic structure of the region. Second, it was necessary to examine a wide range of new products and processes in many fields of technology to determine those which could be economically produced in New England. Third, it was necessary to investigate the actual and potential markets available to manufac-

turers who wished to expand the output of present products or produce new products.

The first step — the review of the structure of the New England economy — was expedited by the existence of a large number of economic base studies, which provided a composite picture of the fundamental economic characteristics of the region and its major industries. But the use of assembled economic information was merely a preliminary step toward the research operations conducted in each industry.

The second step consisted in examining a large number of new products and technical processes which either had demonstrated vigorous growth or which held that promise. This was a matter of putting together what was known about New England's resources with what was known about technologic growth in order to arrive at a series of suggestions regarding products and industries which might be expected to prosper in New England in future years.

For example, it seems quite clear that the region's research facilities and adequate labor supply lend strong support to the electronics industry. On the other hand, despite the national growth of the chemical industry, it seems unlikely that New England's participation will be as substantial as that of regions which have sources of crude oil and gas for manufacture of petrochemicals or sources of low cost power for the manufacture of electrolytic chemicals. This kind of reasoning exemplified the primary method used in this survey; it was developed in particular detail for a large number of products discussed in the report. It can be noted that the use of this method involved many staff members of Arthur D. Little, Inc., in such diverse fields as chemistry, chemical engineering, electrical engineering, mechanical engineering, applied physics, market research, food technology and economics.

The third step involved investigating the adequacy of markets available to New England manufacturers of new products, and of present products in cases where expansion of output was considered. This phase of the work usually developed concurrently with the technical investigations of the earlier phase. Working within the framework of what could be economically produced in New England, our investigators tried to substantiate for each product or industry that a sufficient market existed either in the region or nationally to justify further investigation on the part of a development agency or business company.

As a final note on method, it can be observed that the findings have been checked with numerous industrial companies both in New England and elsewhere. Although the findings are broadly supported by the experience of industry and development agencies, it must be emphasized that this report is not an opinion survey. It rests primarily on scientific and marketing research by a technical staff.

Uses

This report has been prepared with the intention of making available to public authorities and private business preliminary evaluations of a wide range of industrial opportunities. It contains discussions of many specific opportunities which, in the opinion of Arthur D. Little, Inc., are worthy of further investigation. This report stops short of the intensive investigation which would be required before embarking on actual development of any specific opportunity.

Not all of the situations which we have examined appear favorable for development in New England. Although it would have been possible to report only the industrial situations which were promising, the assignment has been construed broadly to include the reporting of negative as well as positive results. The recording of negative results in certain instances should serve to redirect development effort to the important opportunities which hold greater promise for New England.

In broad outline this study is intended to direct the thinking of development agencies and businessmen to the industrial opportunities inherent in New England. The growth of some of these opportunities is already evident from statistical trends. The potentialities of many situations lie unrevealed in the future. The utilization of New England's resources in a manner suggested by modern technology should do much to initiate the growth of industries which are likely to be important in the years to come.

ARTHUR D. LITTLE, INC. REPORT

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Monthly Review
FEDERAL RESERVE BANK OF BOSTON

New England Industrial Mobilization

PLANT CONSTRUCTION for defense output is adding much more than trimming to New England's industrial "new look." Manufacturers in the metalworking centers of New England are leading in the expansion of plant capacity, and power companies are moving rapidly to stay ahead of growing power needs. Many are seeking and receiving certificates of necessity which allow speeded write-off of the defense-related portion of new plant costs.

By August 27, New England firms had received 1,022 certificates representing $819 million of proposed investments. After the exclusion of the proposed New England steel mill, because its certificate expired August 11, the total drops to $591 million. This sum is large in terms of an addition to New England productive capacity, but it is only 2.5 per cent of the total value of certificates granted nationally. New England manufacturers have not participated in the expansion program in proportion to their 8.3 per cent share of the nation's manufacturing output.

New England's participation in the certificate of necessity program has concentrated in manufacturing and power-production activities. About 64 per cent of all proposed investment under the program in New England has a manufacturing plant label. Only 58 per cent of the national total is in manufacturing. Producers of electric power have received 27 per cent of the value of New England certificates in contrast with their share of only 13 per cent in the national total. This dual concentration reflects the industrial structure of the region's economy as well as the regional scarcity of basic minerals available for commercial development.

Within the manufacturing sphere of activity there is new evidence that New England is operating as a national machine shop. About 20 per cent of the proposed investment in the nation's plants making metalworking machinery and ball- and roller-bearings is scheduled for New England. These expansion plans build up the nonelectrical-machinery industry group so that it accounts for 18 per cent of New England's certificates. Nevertheless, it yields first place to the transportation-equipment industry.

The foremost recipient of certificates of necessity in New England is the United Aircraft Company. Its expansion program in the Hartford, New Haven, and Bridgeport areas of Connecticut totals more than $81 million, about 23 per cent of the value of all certificates issued to New England manufacturers. Other expansions in the aircraft industry, including the $4 million heavy forge project of the Wyman Gordon Company in Worcester, bring the industry total up to $105 million, 30 per cent of the regional manufacturing total as of June 20, 1952.

In third place among the major manufacturing industries, the producers of pulp and paper account for 15 per cent of the region's certificates of necessity. A single $30 million newsprint project by the Great Northern Paper Company at East Millinocket, Maine, accounts

NEW ENGLAND'S CERTIFICATES OF NECESSITY
June 20, 1952

*MAJOR OCCUPATIONAL GROUPS**

Group	N. E. Total ($ Thous.)	% Distribution	U. S. Total ($ Thous.)	% Distribution
All Groups	**$539,117**	**100.00**	**$21,067,262§**	**100.00**
Agriculture	—	—	11,207	0.05
Mining	—	—	1,323,993	6.28
Construction	—	—	37,090	0.18
Manufacturing†	347,155	64.38	12,196,799	57.89
Transportation & Storage	35,080	6.51	4,029,071	19.12
Communication	—	—	39	—
Electric Light & Power	145,879	27.07	2,937,896	13.95
Gas, Natural & Manuf.	—	—	256,098	1.22
Electric Light & Gas Comb.	—	—	113,971	0.54
Other Public Utilities	—	—	6,300	0.03
Wholesale & Retail Trade	1,141	0.21	66,968	0.32
Petroleum Storage	8,541	1.58	65,472	0.31
Miscellaneous Services	1,321	0.25	22,368	0.11

*MANUFACTURING INDUSTRIES**

Industry Group	N. E. Total ($ Thous.)	% Distribution	U. S. Total ($ Thous.)	% Distribution
All Manufacturing†	**$347,155**	**100.00**	**$12,196,799§**	**100.00**
Durable Goods	**$245,525**	**70.72**	**$ 7,269,618**	**59.59**
Ordnance	12,336	3.55	268,577	2.20
Lumber	734	0.21	40,568	0.33
Wood Prods. & Furn.	30	0.01	1,464	0.01
Stone, Clay & Glass	3,771	1.09	306,195	2.51
Primary Metals Prods.†	28,353	8.17	4,465,358	36.61
Fabricated Metal Prods.	6,496	1.87	140,081	1.15
Machinery	63,404	18.27	657,722	5.39
Metalworking Mach.	(40,097)	(11.55)	(204,332)	(1.68)
Ball & Roller Bearings	(15,968)	(4.60)	(79,386)	(0.65)
Other Machinery	(7,394)	(2.12)	(374,004)	(3.07)
Electrical Mach.	23,276	6.71	365,023	2.99
Transportation Equipment	107,070	30.85	1,024,630	8.40
Motor Vehicles	(94)	(0.03)	(110,187)	(0.90)
Aircraft	(105,833)	(30.49)	(864,116)	(7.08)
Ships and Boats	(1,143)	(0.33)	(22,784)	(0.19)
R. R. and Other	—	—	(27,543)	(0.23)
Nondurable Goods	**$101,630**	**29.28**	**$ 4,927,181**	**40.41**
Food	—	—	10,518	0.09
Textiles	1,504	0.43	62,999	0.52
Apparel	61	0.02	962	0.01
Paper and Pulp	52,571	15.15	745,892	6.12
Printing	390	0.11	8,164	0.07
Chemicals	29,591	8.53	2,416,173	19.81
Pharmaceuticals	(18,342)	(5.29)	(99,277)	(0.81)
Plastic Materials	(6,898)	(1.99)	(129,976)	(1.07)
Other Chem. Prods.	(4,351)	(1.25)	(2,186,920)	(17.93)
Petroleum & Coal Prods.	9,791	2.82	1,425,329	11.69
Rubber	5,800	1.67	117,169	0.96
Leather	—	—	148	—
Instruments	1,598	0.46	128,386	1.05
Miscellaneous Mfg.	324	0.09	11,441	0.09

*New England and United States figures are not strictly comparable because New England figures have not been adjusted for certificates cancelled or withdrawn.

†Excluding an expired certificate of $228 million held by the New England Steel Development Corporation.

§This total includes certificates issued outside the United States amounting to $184,391,000 which could not be segregated in making the industry analysis.

Source: New England figures reclassified from DPA releases by Federal Reserve Bank of Boston.
United States data from DPA report, "Federal Aids for Facilities Expansion," July 10, 1952.

for the lion's share of the $52 million industry total.

Another nondurable-goods industry ranks fourth among the major recipients of certificates in New England. The chemical industry has received approval for $29 million in proposed investment. Projects by Chas. Pfizer Company to produce penicillin and other drug products in Groton, Connecticut, account for more than 60 per cent of the industry's regional total.

More than a third of the nation's expansion using speeded write-off of plant cost is scheduled for the primary metals industry. In contrast, only eight per cent of New England's expansion falls in this category. In response to the growing local demand for aluminum, the United Smelting and Aluminum Company, Inc., has scheduled a $12.9 million aluminum sheet plant for New Haven. This single project is 45 per cent of the industry total in the region.

About ten per cent of the defense-related expansion in communication equipment is slated for New England. The certificates issued to Raytheon, Hytron, and Sylvania which provide for electronic plant and equipment boost the share of the electrical machinery industry to 6.7 per cent of the regional total.

The New England ordnance industry has also scheduled an expansion of $12.3 million in the program. Otherwise, no industry group has received as much as three per cent of the total value of manufacturing certificates granted in New England. It is interesting to note that while 916 certificates of necessity have been issued to New England manufacturers, 29 certificates granted to ten large firms accounted for just one-half of the regional total as of August 27, 1952.

Electric power companies in New England have developed construction plans to match higher forecasts of future demands. In the three years ending in 1954, New England power companies now plan to expand generating capacity by 18 per cent. To assist this expansion, they have received certificates of necessity covering a proposed investment of $146 million, about 27 per cent of those issued in the region. Nearly five per cent of the nation's certificates for electric power development have been granted to New England firms, although the region's power producers plan only three per cent of the nation's expansion in power facilities through 1954.

The metalworking centers of Connecticut and eastern Massachusetts are leading the parade in expansion of essential plant and equipment. Hartford clearly leads all other New England metropolitan areas in volume of proposed investment using certificates of necessity. Hartford producers have received 13.7 per cent of the region's certificates of necessity, principally because of expansion in the aircraft industry. With the additional support from New Haven, New Britain and Bridgeport, Connecticut expansion plans account for slightly more than half of all New England's certificates.

The metropolitan area of Boston and the state of Massachusetts hold second positions in their respective classifications of New England recipients of rapid amortization approvals. The large expansions in paper and pulp facilities in Maine place that state in third place with 13.3 per cent of the regional total. New Hampshire with 4.5 per cent, Rhode Island with 2.7 per cent, and Vermont with 1.7 per cent of the regional total follow in that order.

Trust Departments Less Profitable in 1951

FIFTY-FIVE New England banks participated in the survey of trust department income and expenses for the year 1951. More banks took part in the study this year than ever before. The reporting trust departments held assets in all types of accounts valued on their books at nearly $5.7 billion. With an aggregate trust department income of over $17 million, they represent a major portion of trust department banking in New England.

Forty-five trust departments which reported their 1951 income and expenses also reported similar data for the previous year. Gross operating income of these trust departments rose 8.4 per cent. Thirty-two trust departments had an increase in income, and 13 showed a decrease. There was a wide range in both increases and decreases in income. Most of the larger banks made a gain in income. Only three trust departments with total income in excess of $200,000 had a year-to-year decline in revenue. Ten of the 23 participants with less than $200,000 of gross income showed a decrease in total revenue from 1950 to 1951.

Costs Increased

Total expenses not including income taxes rose from 1950 to 1951 in every trust department except one. They exceeded those of the preceding year by 10.6 per cent in the typical trust department. Changes in costs were much more uniform than changes in income, since it is difficult to eliminate or cut many of the expense items, while some sources of income vary quite widely from year to year.

Since costs generally increased faster than income, net earnings of the 45 comparable trust departments decreased almost four per cent from 1950 to 1951. Net earnings were higher in 18 banks, but lower in 27. The decline in net profit was particularly marked in smaller trust departments.

Most of the figures discussed in the remainder of this article are averages for all the 55 trust departments which reported their 1951 experience. There was considerable variation in the performance of many trust departments around some of these averages. Individual departments will generally be on sounder ground if they compare their operating results with those of trust departments of similar size. More detailed figures are available to banks which participated in the study.

For the year 1951, two trust departments reported a net profit on their total business for every one that had a loss. The average net earnings to income ratio among the 55 trust departments was 5.9 per cent. Individual departments dispersed widely around this average. The highest ratio was 48 per cent, the lowest minus 51 per cent. Every trust department with gross income in excess of $200,000 showed a profit. Net earnings before income taxes averaged approximately 20 per cent of total income in those banks. Many of the smaller departments, particularly those with less than $50,000

of gross income, had a loss in 1951. Some of the smaller trust departments, however, had higher net earnings to income ratios than most of the large ones. The size of a trust department, measured by gross income, seems to have more effect on the stability than it does on the size of net earnings to income ratios. There is much greater fluctuation in net earnings among the smaller trust departments, both from one bank to another and from year to year within the same bank, than in larger ones.

The average reporting trust department obtained 49.8 per cent of its income from personal trusts and guardianships, 22.6 per cent from personal agencies, 21.9 per cent from estates, and 6.1 per cent from corporate trusts and agencies. Estates generally accounted for a larger portion of total income in smaller trust departments than in the larger ones. Corporate accounts were concentrated mainly in the larger departments. Seven out of 11 banks which reported income and expense figures separately for corporate accounts showed a profit, but the 11 participants had an average net earnings to income ratio of only 2.1 per cent from corporate accounts. This compares with an average net profit of 6.1 per cent from personal accounts among the 50 banks which reported such data separately. Personal agencies were slightly more important as a source of income in large departments than in small ones. The proportion of income derived from personal trusts showed no correlation with size of trust department.

Expenses

An accompanying table shows the various types of direct operating expenses as percentages of total expenses before overhead in the typical trust department in five different size groups. Because a well-trained permanent staff is needed to handle the many different problems raised by individual accounts, salaries and wages made up the greatest expense item. They averaged 68.8 per cent of total direct expenses among the 55 banks. While the total amount charged to salaries and wages showed no tendency to correlate with the size of trust departments, smaller banks generally spent a relatively greater amount for officers' salaries and a smaller sum for clerical wages than did the larger ones. Expenditures for employee pension and retirement purposes averaged 3.8 per cent of total expenses before overhead among the 38 departments that had such expenses. Large banks almost invariably contributed a greater relative amount for pensions than small ones. When other types of personnel expenses such as those for social security, unemployment compensation, insurance premiums, and fidelity bonds are added to salary and pension charges, the total of all personnel expenses amounted to nearly 76 per cent of total direct costs in the typical trust department.

Expenditures connected with occupancy of quarters was the second highest cost item. They comprised 7.5 per cent of direct operating expenses in the average bank. Their relative importance was lower than in previous years, indicating that most other costs, particularly those connected with personnel, increased faster than did charges for such items as heat, light, power, rent, real estate taxes, and maintenance.

Other types of direct operating expenses were relatively small. Furniture and equipment charges generally accounted for a greater portion of total costs in the larger departments, probably because they have more opportunity to use mechanical procedures. Expenses of information services, examinations, and directors' and trust committee fees were usually of greater relative importance in the smaller departments. The other types of direct expenses did not vary much among different sizes of trust departments.

Overhead averaged 14.9 per cent of direct operating expenses among all trust departments. Twenty-eight reporters estimated their overhead as 15 per cent of the total direct expenses of the trust department. Fifteen determined overhead by detailed analysis and summation. They arrived at an overhead allowance of 13.6 per cent. Five banks allocated overhead to their trust departments in the same proportion that direct trust department expenses bore to direct expenses of all other departments of the bank. They showed an average overhead ratio equal to 17.9 per cent of direct operating expenses of their trust departments.

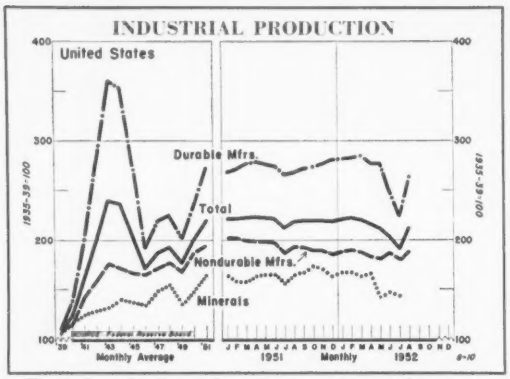
TRUST DEPARTMENT EXPENSES OF 55 N. E. BANKS IN 1951

Percentage Distribution by Size of Trust Department Income

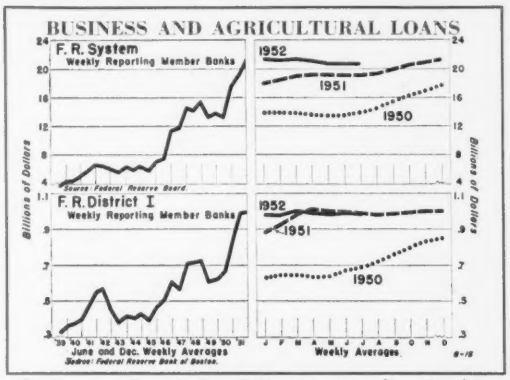
Trust Department Expense Item	*1951 Trust Department Income (In thousands of dollars)*					
	Over $500 (8 Banks)	*$200 to $500 (10 Banks)*	*$100 to $199 (6 Banks)*	*$50 to $99 (15 Banks)*	*Under $50 (16 Banks)*	*All 55 Banks*
	Percentage of Total Expenses Before Overhead					
Salaries and wages	68.0	68.7	68.5	69.2	68.8	68.8
Pensions and retirements	5.7	3.8	4.9	3.1	2.4	3.8
Social security programs	2.2	1.7	1.8	1.5	1.4	1.7
Personnel insurance	1.2	1.7	1.8	1.6	1.7	1.6
Occupancy of quarters	8.0	7.2	7.3	8.0	7.1	7.5
Furniture and equipment	3.5	2.2	2.6	1.6	1.1	2.0
Postage and supplies	4.0	4.1	3.5	3.8	3.5	3.7
Telephone and telegraph	1.2	1.2	1.4	1.2	1.4	1.3
Advertising	1.8	1.8	2.8	2.4	4.2	2.7
Directors' fees	0.9	1.5	1.7	2.1	2.2	1.8
Legal fees	0.3	1.2	0.2	1.2	2.1	1.1
Information services	0.8	1.3	1.6	1.9	3.3	1.8
Examinations	0.5	0.9	1.6	1.8	2.3	1.6
Miscellaneous expenses	1.8	3.2	2.1	2.9	1.6	2.4
Total expenses before overhead and income taxes*	100.0	100.0	100.0	100.0	100.0	100.0
Overhead	15.6	13.7	11.5	16.3	15.5	14.9

*Details do not add to 100 in all cases because of the averaging technique used and because of rounding.

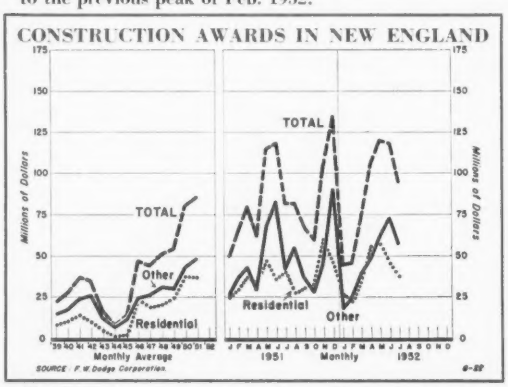
Business Conditions



The index of industrial production rebounded in Aug. to the highest level since April. The durable-goods industries accelerated production as steel production resumed. Output of soft goods in Aug. climbed nearly to the previous peak of Feb. 1952.

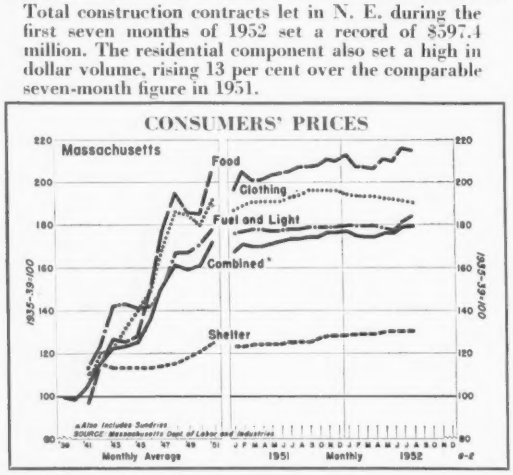


Business and agricultural loans outstanding in the U. S. declined for the fourth month in July, but were 8 per cent higher than a year ago. In N. E., the level of loans rose in early summer but declined in July and was slightly lower than in July 1951.

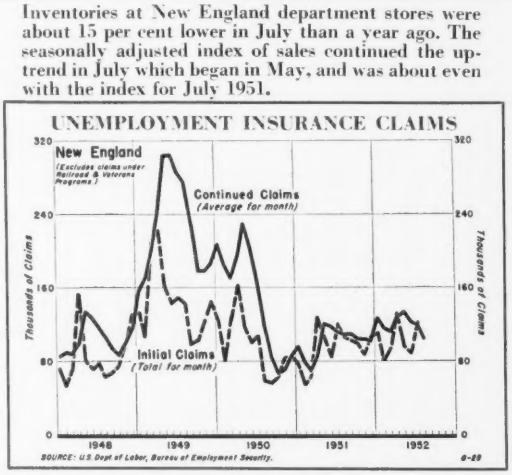


Total construction contracts let in N. E. during the first seven months of 1952 set a record of $597.4 million. The residential component also set a high in dollar volume, rising 13 per cent over the comparable seven-month figure in 1951.

Inventories at New England department stores were about 15 per cent lower in July than a year ago. The seasonally adjusted index of sales continued the uptrend in July which began in May, and was about even with the index for July 1951.



Average retail prices in large Mass. cities during Aug. stood about 3 per cent higher than a year ago and 12 per cent above pre-Korea levels. The food component rose the most after June 1950, 17 per cent, while clothing showed the smallest increase.



In Aug., continued claims for unemployment benefits in N. E. fell below the year-ago level for the first time this year. Employment picked up in the shoe and textile centers, and among the durable-goods industries which had been affected by steel shortages.